INTERNATIONAL FORUM ON URBANISM
TU Delft OPEN

ARCH22 'Enabling health, care and well-being through design research'
5th Architecture Research Care and Health conference
Delft / Rotterdam – the Netherlands – 22nd until 24th of August 2022.

Type of the Paper: Peer-reviewed Conference Paper/ Full Paper

Track title: user-needs

Workplace Utilization in hospitals – a study of space efficiency potentials

Stefanie Lange [1*], Eunji Häne [2], and Lukas Windlinger [3]

[1] ZHAW Institute of Facility Management; Stefanie.Lange@zhaw.ch; ORCID ID: 0000-0002-8928-7663
[2] ZHAW Institute of Facility Management; Eunji.Haene@zhaw.ch; ORCID ID: 0000-0001-8367-1587
[3] ZHAW Institute of Facility Management; Lukas.Windlinger@zhaw.ch; ORCID ID: 0000-0001-9762-8504

* corresponding author.

Abstract: Administrative non-patient workstations of medical staff are often rarely occupied, as physicians use various spaces in their daily routine. Occupancy data for administrative workplaces in hospitals are scarce but needed as a basis for planning for costly projects. Thus, the objective of this secondary data analysis was to compare the occupancy rate of traditional administrative offices to medical offices in hospitals. Additionally, the activities performed at the workstation are compared. Occupancy data resulting from Space Utilization Surveys in 14 offices were compared with data from for hospitals projects. The data results from multi-moment observations that were conducted twice per hour on three days while presence and activity patterns were collected. The office data and the hospital data were analyzed descriptively. Average occupancy and activities were studied and recognised that compared to offices, workstations in the hospitals have significantly lower occupancy rates. Activities at workstations in hospitals and activities in offices are significantly different. The results show more communication activities in hospitals and less computer work compared to offices. According to this analysis space efficiency potentials exist. The results indicate that the way workstations are used in hospitals is different from traditional offices. Medical staff spend a large part of the working day away from their backstage desks. However, the use of desks is less plannable as in offices and changes of room take place frequently. Therefore, it's unclear whether the efficiency potentials can be realized in a way as for administrative offices.

Keywords: space utilization study, administrative workplaces in healthcare, space efficiency, workplace management

Names of the track editors:
Firstname Lastname
Firstname Lastname

Names of the reviewers:
Firstname Lastname
Firstname Lastname

Journal: The Evolving Scholar

DOI:10.24404/62ff531281d866c69b96b290

Submitted: 19 Aug 2022
Accepted:
Published:

Citation: Lange, S., Häne, E. & Windlinger, L. (2022). Workplace Utilization in hospitals – A study of space efficiency potentials [preprint]. The Evolving Scholar | ARCH22.

This work is licensed under a Creative Commons Attribution BY-ND (CC BY-ND) license.

© 2022 [Lange, S., Häne, E. & Windlinger, L.] published by TU Delft OPEN on behalf of the authors.

1. Introduction

The number of hospitals in Switzerland has been reduced by 21% over the last 20 years (Hplus, 2021). At the same time, population growth and a steady improvement in medicine took place, resulting in more cases per hospital (BfS, 2021). For hospital employees, this means more patients, more work, and more staff in existing building structures. The limited availability of space also led to densification of administrative workplaces in offices and often called for ad hoc solutions to accommodate growth.

In recent years, a national hospital renovation wave has started in Switzerland (Medinsight, 2020), and those in charge are challenged to make strategic decisions for the next years or decades. Regarding administrative workplaces, modern, open office types and desk-sharing concepts, as known from offices outside the healthcare sector, are increasingly being adopted for future hospitals. Cell offices in the form of individual and group offices are considered too inefficient in terms of space.

Reasons for these workplace strategies are obvious: administrative workplaces of medical staff that are far away from patients are often only partially utilized, as doctors use other places in their daily hospital routine. Space efficiency potentials are thus obvious in the context of multi-local working. However, until now, it is unclear how much and for which activities the doctors' backstage and non-patient office workplaces are used. Recent case-related utilization figures and benchmarks are missing as a basis for decision-making and planning. Existing research about workplace utilization in hospitals either was conducted many years ago (Rawlinson, 1978) or does not differentiate between public (patient area) and backoffice (non-patient area) workplaces (Wenger et al., 2017).

In order to measure the occupancy of the administrative workplaces and document the activities of the medical staff at the workstations, space utilization studies were conducted. Activities are categorized into communication onsite, digital communication, deskwork and break. Occupancy data were collected in four projects in three hospitals by means of a space utilization study. Observations were conducted on three to five consecutive workdays in each project. The use of the workstations was systematically documented twice per hour. The data on utilization and modes of use were then analyzed descriptively and compared with a data set of 14 office buildings.

2. Theories and Methods

Alignment of workspace to users is a crucial process in corporate real estate management (Vischer, 1996). Work organizations generally want to provide workplaces that maximally support employees' work activities and processes while keeping cost and environmental footprint as low as possible. Space utilization analyses provide important information for finding the right balance between the number and activities of employees on the one hand and the type and amount of different work settings (such as workstations, meeting rooms, private offices, and support spaces) on the other hand. Therefore, strategic workspace decisions are often based on accommodation and occupancy intelligence (Vischer, 1996) and combined with organizational data and calculation mechanisms (De Bruyne & Beijer, 2015).

Space Utilization Studies (SUS) can be used as an analysis instrument in projects. SUS consist of observations of when and how work settings are used. The observations are either performed as structured and standardized visual inspections or by applying electronic methods (see Tagliaro et al., 2021). The main advantage of visual inspections over electronic methods is that not only occupancy is recorded, but also the activities carried out at specific places. This provides information on which activities are performed where and how often. This information allows identifying the kind of support spaces needed by the workers and organizational units observed. SUS, therefore, contribute to evidence-based planning and design of administrative workplaces in healthcare (cf. Fröst, 2016). Furthermore, basing the design of work environments on data follows a human-centred approach that focuses on employees' needs, capabilities and behaviours and aims to design environments that accommodate them. Such an approach emphasizes the usability of the environment for the users over the technical quality (cf. Windlinger & Tuzcuoglu, 2021).

While evidence-based (e.g. Becker & Parsons, 2007) and human-centred (see Fornara & Andrade, 2012) approaches in the design of healthcare facilities have long been called for, no studies on the utilization of administrative (and other) work settings in hospitals have been published up to now.

2.1. Aim and Objectives

The aim is to compare the occupancy rate of medical administrative workstations in hospitals with the occupancy rates of offices in other industries. In addition, the activities performed at the workstations are analyzed and compared. The findings on the utilization of hospital workplaces will lead to an improved understanding of workplace management in the context of medical work environments.

The objectives of the study are to:

a. compare the utilisation of workplaces in traditional offices with the utilisation workplaces in hospitals
b. compare the activities performed at the workplaces in traditional offices and workplaces in hospitals
c. understand the use of administrative, back-office workplaces in general hospitals in Switzerland and identify potentials regarding space efficiency.

2.2. Study Design

The study consists of a secondary analysis of existing data from previous projects. Data from two groups of projects are included: data from non-patitent offices in hospitals and data from traditional offices. Data is used for a comparison of hospital and office workplaces.

2.3. Setting and Sample

Administrative medical workplaces in four hospitals were observed between 2017 and 2021. Information about each hospital project, such as project year, office concept, and the number of observed workstations, can be found in Table 1. Three hospitals used a traditional office concept, and one hospital implemented an activity-based working office concept as a pilot. The traditional concepts included single and group offices, which were used with a fixed allocation as a single (one person, one desk) or shared workplace (several people, one desk). Often several employees shared a workstation. Higher management levels usually had their own workstation or office room.

All workplaces observed were used only for administrative work and internal communication. No patient contact or treatment occurred in these rooms.

Table 1: Overview of hospitals projects

Project-name and year	**Hospital information**	**Office concept**	**Number of WS «Physicians»**	**Number of WS «Nursing staffs/ Therapists »**	**Number of WS «management /administration staff»**
H1, Department A 2017	University hospital A, approx. 900 beds, approx. 8,500 employees	Cell offices and group offices	112	132	62
H1, H1, Department B 2020	University hospital A, approx. 900 beds, approx. 8,500 employees	Cell offices, group offices, and ABW office zones	33	N/A	30
H2, 2020	Regional hospital, approx. 240 beds, approx. 1,700 employees	Cell offices	64	N/A	N/A
H3, 2021	University Hospital B, approx. 780 beds, approx. 7,200 employees	Cell offices and group offices	53	N/A	47

Note: WS= Workstation

The data set of office buildings includes data from 14 observation projects (Table 2). The total number of workstations is 3'534 and the total number of observed cases is 178'002. In these projects, administrative units of private sector companies with different office concepts, such as Activity Based Working (ABW, see e.g. De Bruyne & Beijer, 2015), multispace or traditional group offices, were observed.

Table 2: Overview of office projects

Project number	Year	Office type	Number of Work-stations	Number of obser-vations	WS Occu-pied	WS Empty
O1	2011	ABW	80	5891	48%	52%
O2	2011	Open structure	91	4632	41%	59%
O3	2011	Open structure	154	6599	39%	61%
O4	2011	Open structure	207	6523	38%	62%
O5	2012	Open structure	116	6240	42%	58%
O6	2012	Open structure	143	7687	46%	54%
O7	2013	Open structure	199	10152	45%	55%
O8	2013	Cell office	236	12055	40%	60%
O9	2014	Open structure	272	13588	26%	74%
O10	2014	Open structure	182	9170	40%	60%
O11	2014	Open structure	633	34386	39%	61%
O12	2015	ABW	281	14271	30%	70%
O13	2016	Open structure	158	8162	34%	66%
O14	2016	Open structure	782	38646	39%	61%

2.4. Data Collection and Analysis

The Space Utilization Study focuses on the use of space or workplaces. Here, the investigations were conducted as observational studies since occupancy measurement via electronic methods prevents the recording of activities.

Only data from standard workstations were included in the study. Data from other places like meeting facilities, think tanks, and recreation areas were only available in one case of activity-based working and excluded because the dataset was too small. Users of the offices observed were physicians, non-medical professionals, nurses, and employees with strategic or administrative functions.

The occupancy of the workstations was documented in two projects with three categories: "occupied", "empty" or "cold occupation" (workstation is occupied but currently not used) and in two projects with only two categories: "occupied" or "empty". For the data analysis, the records with information on "empty" and "cold occupation" were summed and recoded into the "empty" category. After this adjustment of the datasets, they were comparable. The background for the adjustment is a changed observation logic for hospital workplaces as compared to office workplaces from other industries. This is because the category "cold occupation" is challenging to identify in hospitals with traditional office concepts lacking clean desk routines.

As categories of the activities in four projects were documented differently, activities of occupants were merged and recategorized into "communication onsite", "digital communication", "deskwork" and "break". Communication onsite refers to communication with colleagues in the same room, whereas digital communication includes any communication using telephone or computer. Deskwork includes all quiet tasks like reading and writing. When people relaxed or ate at their desk it was documented as break.

Adopting the procedure of a systematic space utilization study, workstations were observed following a regular observation grid on a fixed route within the defined observation area. The observation grid specified data collection every 30 minutes between 7:00 am, and 6:00 pm in hospitals and 8:00 am and 5:00 pm in offices for three to five days in each project. In total, 4067 (533 hospital- and 3534 office-) workstations were observed, and 216'862 (38’860 hospital- and 178’002 office-) observations were generated for the analyses.

Observation data were collected by students. Students received 2 hours of training on how to conduct an observation and navigate to the observation points. Paper and pencil were provided, and data were transferred directly into Microsoft Excel spreadsheets. After combining all data, mistakes from the transfer and errors were eliminated.

Data were analyzed using descriptive statistics, and comparisons using chi-square tests were carried out.

3. Results

3.1. Occupancy of workplaces in hospitals

A frequency analysis of physicians' administrative workplaces in hospitals was conducted. Physicians were divided into two groups (chief physician & chief of service; resident physician & attending physician) according to their tasks and roles. The groups were not subdivided further in order to ensure anonymity, which could be impaired by resulting in too small group sizes. The number of observed workstations of the two groups were not significantly different (chief physician & chief of service: 106, resident physician & attending physician: 127). The observed workstations of chief physician & chief of service showed a higher occupancy rate: 37% of the observed workstations of chief physician & chief of service were occupied, whereas 23% of the observed workstations of resident physician & attending physician were occupied.

In the next step, the occupancy of administrative office workplaces in hospitals was analyzed regarding occupant type. Occupants were divided into three types (physicians; nursing staff & therapists; management/administrative staff). The number of observed workstations of physicians was nearly twice that of others (physicians: 262, nursing staff & therapists: 132, management /administrative staff: 139). Among the three groups, observed management /administrative staff workstations had the highest occupancy rate with an average of 37%. The occupancy rates of physicians, nursing staff & therapists were both under 30% (physicians: 29%, nursing staff & therapists: 27%). Table 3 summarises the occupancy rates of the three employee types.

Table 3: Occupancy regarding physician types, other hospital occupant types

Project-name and year	WS Occupancy by «Physicians: chief of service and chief physician»	WS Occupancy by «Physicians: resident physician and attending physician »	WS Occupancy by «Nursing staffs / therapists»	WS Occupancy by «Management/administration staff»
H1, 2017	Occupied: 22% Empty: 78% (n=30)	Occupied: 19% Empty: 81% (n=79)	Occupied: 27% Empty: 73% (n=132)	Occupied: 43% Empty: 57% (n=62)
H1, 2020	Occupied: 20% Empty: 80% (n=8)	Occupied: 28% Empty: 72% (n=22)	N/A	Occupied: 29% Empty: 71% (n=30)
H2, 2020	Occupied: 46% Empty: 54% (n=64)	N/A	N/A	N/A
H3, 2021	Occupied: 40% Empty: 60% (n=4)	Occupied: 33% Empty: 67% (n=26)	N/A	Occupied: 35% Empty: 65% (n=47)
Total	Occupied: 37% Empty: 63% (n=106)	Occupied: 23% Empty: 77% (n=127)	Occupied: 27% Empty: 73% (n=132)	Occupied: 37% Empty: 63% (n=139)

Note: Workstations not assigned by physician types are not included in this table.

3.2. Activities of occupants in hospitals

A frequency analysis of occupants' activities in hospital offices was conducted. Activities were analyzed in the same four groups as occupancy: chief physician & chief of service; resident physician & attending physician; nursing staff & therapists; management/administrative staff. Figure 1 shows the percentile of activities regarding physician

types and other hospital employee types and illustrates a similiar proportion of activities for the four groups. The most frequent activities were deskwork with more than half of all activities during the observation. Especially resident physician & attending physician were observed at deskwork for 74% of the observed time. The second most observed activities were communication onsite. Communication onsite of resident physician & attending physician was observed at 16% of the observed time, whereas communication onsite of nursing staff & therapists was observed at more than 31% of the observed time. Both digital communication and break were observed in less than 10% of the observed time.

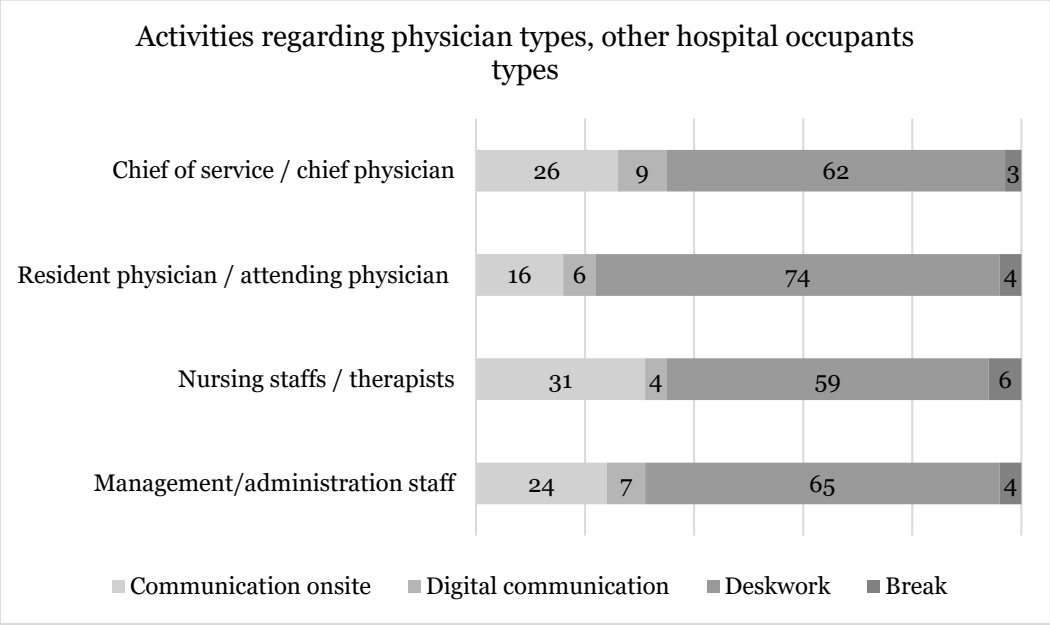

Figure 1: Activities regarding physician types, other hospital occupants types

3.3. Comparison of workplace utilization and activities in hospitals and office buildings

Lastly, occupancy rates of workplaces in offices and hospitals were compared using frequency analysis. The observed workstations of office projects had a higher occupancy rate than those in hospitals (figure 2): 38% of the observed workstations of office projects were occupied (see table 2 for information on the occupancy of workstations in offices), whereas 31% of the observed workstations of hospital projects were occupied.

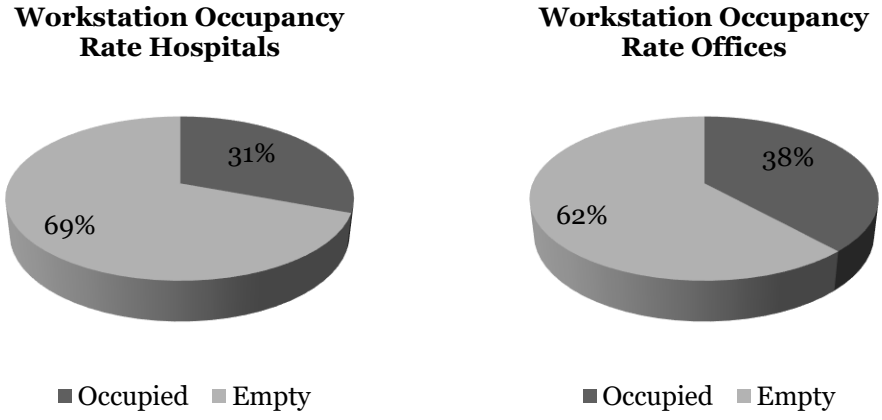

Figure 2: Occupancy rates of workplaces in hospitals and offices

To complete the comparison, a frequency analysis was conducted in order to compare activities of occupants in workplaces in hospitals and office buildings. Results are illustrated in figure 3. Both communication onsite and digital communication are remarkably

more observed in the hospital (29%) than the office buildings (17%). However, deskwork was observed less in the hospital (67%) then the office buildings (82%). This indicates that the occupants of hospitals spent more time in communication and less time in deskwork in heads down or administrative workplaces compared with one in office buildings.

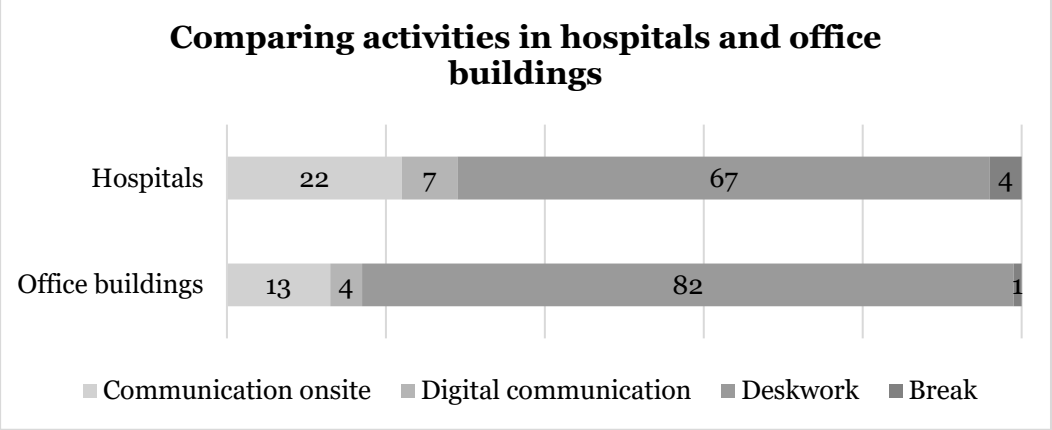

Figure 3: Activities in hospitals and office buildings

4. Discussion and conclusions

The utilization of administrative workplaces in hospitals is low. Medical staff spend a large part of the working day away from their backstage (non-patient) desks. Therefore, on a generally low occupancy level, the occupancy rate in hospitals is lower than in administrative offices, where the workstation is the central place of work.

These results suggest significant space efficiency potentials. Theoretically, workstations could be shared, i.e. instead of assigning employees to specific places, workstations and support spaces could be used by a defined group of employees. Considering the low occupancy rates, the number of workstations could be reduced through desk-sharing.

Before implementing desk-sharing in hospitals, some issues have to be considered: (1) based on our experiences, desk-sharing works better for larger groups than for smaller ones, i.e. the efficiency gains are higher and easier to realize with larger user groups (economies of scale). (2) desk-sharing may affect group identity (Elsbach, 2003) and may conflict with organizational culture. Particularly, the role of workplaces as status markers fundamentally changes with the introduction of desk-sharing (cf. Vischer, 2005). (3) Organisation-specific conditions and work processes of the different user groups must be studied and understood in any case.

Despite low utilization, the administrative workplaces is an important place of work for medical staff. A high workload, long working hours, and daily medical routines result in requirements for the workplace environment that must be considered for future solutions. For example, not only the duration of using a workstation is important, but also the frequency. Frequent short periods of utilization may imply that it would be impractical to put away one's utensils every time and clear the workstation so that colleagues could use it. The same applies for frequently changing activities while using a workstation. Shorter periods of activities, like short phone calls, imply that it would be impractical to change from a desk to a phone both.

Considering the activity patters found in these four hospital projects, the backstage office has to be multifunctional and to support both, concentrated deskwork and communication. This could be very challenging when it comes to open offices with shared desks. Frequent communication may cause interruptions and disruptions of colleagues' concentrated individual work.

There is clearly a need to further analyze the current and future role of administrative workplaces in hospitals regarding their functional, symbolical, and spatial properties.

References

1. Becker, F., & Parsons, K. S. (2007). Hospital facilities and the role of evidence-based design. *Journal of Facilities Management*, 5(4), 263-274.
2. Bundesamt für Statistik (2021). *Anzahl Patienten nach Altersklassen und Anzahl Hospitalisierungen im Lauf des Jahres* [Number of patients by age group and number of hospitalisations during the year]. Retrieved from https://www.bfs.admin.ch/bfs/de/home/statistiken/gesundheit/gesundheitswesen/spitaeler/patienten-hospitalisierungen.assetdetail.20044051.html
3. De Bruyne, E., & Beijer, M. (2015). Calculating NWoW office space with the PACT model. *Journal of Corporate Real Estate*, 17(2), 122-133. doi:http://dx.doi.org/10.1108/JCRE-12-2014-0032
4. Elsbach, K. D. (2003). Relating physical environment to self-categorizations: Identity threat and affirmation in a non-territorial office space. *Administrative Science Quarterly*, 48(4), 622-654.
5. Fornara, F., & Andrade, C. (2012). Health Care Environments. In S. Clayton (Ed.), *The Oxford Handbook of Environmental and Conservation Psychology* (pp. 295-315). Oxford: Oxford University Press.
6. Fröst, P. (2016). Administrative workplaces in healthcare: Designing an efficient and patient-focused environment. *Journal of Hospital Administration*, 5(4), 68-75.
7. H+ Die Spitäler der Schweiz (2019). *Strukturwandel: Grundversorgung immer mehr in Zentrumsspitälern* [Structural change: primary care increasingly in centre hospitals]. Retrieved from https://www.hplus.ch/de/zahlen-statistiken/h-spital-und-klinik-monitor/gesamtbranche/strukturen/spitaeler/spitaltypen
8. Medinside (2016). *Spital-Bau-Boom in der Schweiz: Ist das noch gesund?* [Hospital construction boom in Switzerland: Is it still healthy?]. Retrieved from https://www.medinside.ch/de/post/spital-bau-boom-in-der-schweiz-ist-das-noch-gesund
9. Rawlinson, C. (1978). Space utilization in hospitals. *Journal of Architectural Research*, 4-12.
10. Tagliaro, C., Zhou, Y. Y., & Hua, Y. (2021). A change in granularity: measure space utilization through smart technologies. *Facilities*, 39(1-2), 64-79. doi:10.1108/F-08-2019-0093
11. Vischer, J. C. (1996). *Workspace strategies. Environment as a tool for work*. New York: Chapman and Hall.
12. Vischer, J. C. (2005). *Space meets status. Designing workplace performance*. London: Routledge.
13. Wenger, N., Méan, M., Castioni, J., Marques-Vidal, P., Waeber, G., & Garnier, A. (2017). Allocation of internal medicine resident time in a Swiss hospital: a time and motion study of day and evening shifts. *Annals of internal medicine*, 166(8), 579-586.
14. Windlinger, L., & Tuzcuoglu, D. (2021). Usability theory: Adding a user-centric perspective to workplace management In V. Danivska & R. Appel-Meulenbroek (Eds.*), A Handbook of Management Theories and Models for Office Environments and Services* (pp. 173-183). London: Routledge.